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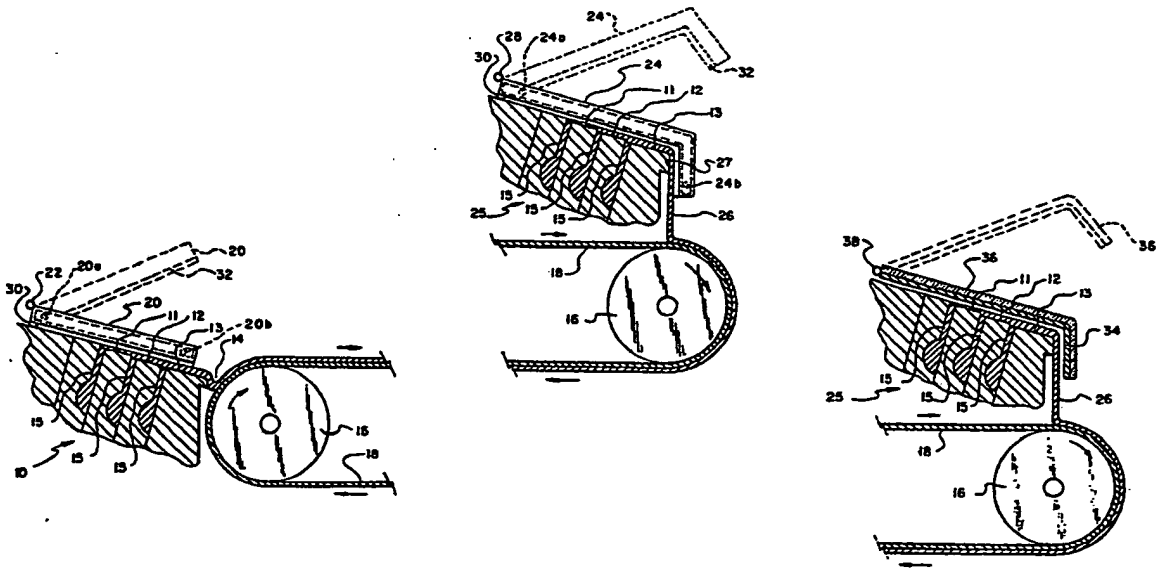
(54) Title: COATING APPARATUS PROVIDED WITH A PROTECTIVE SHIELD



(57) Abstract

Coating apparatus for applying a coating of one or more layers of coating composition to the surface of a continuous web or discrete sections of sheet material. The apparatus includes a cascade slide hopper to supply coating composition to the coating zone. The layer or layers of coating composition flowing down the slide surfaces of the cascade slide hopper are protected from adverse effects of convection air currents by a shield which is positioned so close to the slide surfaces of the cascade slide hopper as to prevent the creation of thermal connection currents. Preferably, the shield is heated to a temperature equal to or above the temperature of the coating compositions to prevent condensation.

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COATING APPARATUS PROVIDED WITH A PROTECTIVE SHIELD

Technical Field

This invention relates to apparatus for coating a web or sheet with a fluid composition as a step in the production of photographic material.

Background Art

Among the many known methods of coating, the only ones capable of achieving the very high quality of uniformity required in the photographic industry are the bead and curtain coating methods. Slide hoppers are employed in both single and multiple-layer bead and curtain coating operations to supply coating composition to the coating zone. Such hoppers comprise one or more slide surfaces, over which one or more layers of coating composition flow to the coating zone. Defects occur when the coating composition flowing over the slide surfaces is exposed to air currents. The air currents impacting on the flowing composition cause disturbances of the surface of the composition which result in non-uniformities in the coating composition as it moves down the slide surface to the coating zone. These non-informities in the composition on the slide surface result in the formation of mottle or other defects in the coating on the web or sheet.

Previous attempts to eliminate the disturbance of flow of photographic coating compositions caused by impact of air surrounding a slide hopper, have not been entirely successful. In some coating rooms, peak air velocities of 200 feet per minute have been measured. The protective enclosures described in U.S. Patent 4,287,240 have been found to reduce air flow around the coating station. The enclosures are formed of a foraminous material and are effective in deflecting, diffusing and decelerating ambient forced air currents. Such

forced air currents are frequently generated by the ventilating and exhausting equipment in the vicinity of the coating apparatus, or by the opening and closing of doors to the coating room, or by movement of personnel in the vicinity of the coating apparatus. The foraminous enclosure is designed to enclose the entire slide hopper and the coating zone, and is not closely spaced to the slide surface of the hopper. Indeed, in U.S. Patent No. 4,287,240 it is stated that the enclosure should be spaced in the range of about 5 to about 60 cms from the coating composition. Optimum results have been achieved with enclosures formed of a plurality of spaced wall members, each of which is composed of a foraminous material. The best enclosures reduce peak velocities of air flow to approximately 25 feet per minute. However, even such velocities have been shown to cause disturbances in the coating compositions on the slide which often appear as broad longitudinal streaks in the resulting coating. In most products these streaks are objectionable.

However, it has been found that even in the total absence of forced air currents, defects still occur which seemed to be due to air currents impacting the flowing composition. It was discovered that the difference between the temperature of the composition flowing over the hopper surfaces, and the temperature of air adjacent the flowing composition, caused thermal convection air currents. Small as these currents might be, it was discovered that the thermal convection air currents impacted the flowing compositions and caused disturbances which result in defects in the coating of the coated web or sheet. The enclosures described in U.S. Patent No. 4,287,240 have been found to be useless in preventing the convection currents.

It is an object of the present invention to reduce or eliminate the defects caused by convection air currents adjacent coating composition flowing over the surface of a coating hopper.

Disclosure of the Invention

The object of the present invention is achieved by providing shield means overlying the surface of a coating hopper over which coating composition flows, in use. The shield means is so closely spaced from the hopper surface that while there is space between the surface of the flowing composition and the shield means it is so small that deleterious convection currents cannot occur.

If it is found that solvent from the coating composition is condensing on the shield means and drops of condensation are falling back onto the coating composition and thereby creating unacceptable defects in the coated web or sheet, then, in accordance with a preferred embodiment of the present invention, heating means may be provided for heating the shield means so that condensation does not occur.

Brief Description of Drawings

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a side elevation of a bead coating apparatus of a slide-hopper type and a closely spaced shield according to the present invention;

Fig. 2 is a side elevation of a curtain coating apparatus of the slide-hopper type and a closely spaced shield according to the present invention; and

Fig. 3 is a side elevation of a curtain coating apparatus of the slide-hopper type and a closely spaced shield in accordance with another embodiment of the present invention.

Best Mode of Carrying Out the Invention

The shield structure disclosed herein is highly effective in a typical production environment wherein thermal convection air current are generated by the coating hopper and the coating compositions flowing on hopper surfaces. Most photographic coating compositions must be kept at temperatures in excess of 35°C during the coating operation, to prevent solidification of the coating liquids. The hopper, used to supply coating compositions, must also be kept at approximately the same temperature to prevent gelation of the coating liquids in the internal cavities and on slide surfaces. The temperature of the ambient air in the vicinity of the hopper is usually dictated by operator comfort and safety and consequently is usually less than 25°C.

It has been found that air movement in the vicinity of the slide hopper may be caused by thermal convection. With gelatin based coating compositions usually coated at temperatures of about 40°C and with the temperature of the coating rooms maintained around 25°C, the coating compositions heat the adjacent air, which then rises by buoyancy. Enclosures of the known kinds give no protection against air flows due to thermal convection.

Bead coating and curtain coating are different methods of coating involving entirely different mechanisms, with the former involving extremely close spacing between the lip of the hopper and the object to be coated, such as a spacing of a few hundredths of a centimeter, and the latter involving a spacing which is hundreds or thousands of times as great. However, both of these methods, in which a flow of coating composition is generated by a cascade slide hopper, are capable of being significantly improved by use of a shield means in accordance with the present invention.

Referring now to the drawings, there is shown in Fig. 1 a multi-slide hopper 10 used in a multi-layer bead coating operation, in which in a coating zone 14 a bead is formed in the extremely close spacing between the lip 40 of the hopper 10 and a web 18 to be coated. The three coating compositions are delivered to the slide hopper 10, ascend to exit slots 15a, 15b and 15c, and form layers on the inclined surfaces 11, 12 and 13, respectively. The lengths of slots 15 are usually equal to the width of the coating applied to the web although it is known that individual slots may vary in length. Under the effect of gravity, the three individual layers flow down the surfaces 11, 12 and 13 and form a three layer flow to the bead at coating zone 14. The three layers of coating compositions are applied simultaneously to the surface of web 18. The web 18 is a continuous web advanced along a predetermined coating path by suitable web-driving means including a backing roll 16 which rigidly supports, positions, and smooths web 18 while also reversing its direction of travel. The slide hopper 10 can be any desired width, such as from several inches to several feet.

To protect the coating compositions flowing over slide surfaces 11, 12 and 13 from thermal convection air currents generated by the slide hopper, where exposed, and the flowing coating compositions, shield means, in the form of a substantially planar shield structure 20, extends over substantially the entire slide surface of the hopper. In Fig. 1 the shield structure 20 is shown in broken lines in an inoperative, retracted position and is shown in solid lines in its operative position. In the operative position, the shield structure does not extend right to the coating bead,

so as to allow the bead to be viewed by operators. It was found that, for best results, the shield structure should be uniformly spaced from composition surface and/or the hopper surface. For an unheated shield, this space from the hopper surface is about 0.6 centimeter. If the shield is heated to or above the temperature of the coating composition, the space can be increased to 1.0 centimeter.

Perforated materials are not preferred for this close proximity shield because these materials must be attached to struts for rigidity. It has been found that these struts cause air flow disruptions which in turn may produce stationary streaks in the coating. A shield surface which is solid and continuous does not have this problem.

The shield structure may be a hollow enclosure made of any rigid material such as, for example, aluminum or steel. Also a rigid plastic material, such as polyolefin, can be used if it is sufficiently rigid to provide a uniform spaced relationship from the hopper surface.

Shield structure 20 includes entry and exit ports 20a and 20b to provide for flow of heating fluid through the hollow shield structure for maintaining the shield surface facing the slide hopper at the desired temperature which is equal to or in excess of the temperature of the coating composition.

Convection air flow between the slide surface of the hopper and the shield can be minimized by closing the space between the shield and the upper slide surface above the uppermost metering slot 15a with a spacer bar 30 attached to the shield.

A second embodiment of the present invention is illustrated in Fig. 2 and is appropriate for use in curtain coating. Parts and features in the second embodiment which are similar to parts and features in the first herein described embodiment, are given the same reference numerals as those parts and features in the first embodiment, but with the addition of a prime (') suffix. Only differences between the second and first embodiments will now be described. For an understanding of aspects of the second embodiment not described below, reference is directed to the description, above, of the first embodiment.

Located above the coating path of the web 18' is a triple slide hopper 25 which forms a three layer falling curtain 26 of coating compositions which impinges on the web 18' as it passes around support roller 16' to deposit on web 18' a coating composed of three distinct superimposed layers. The coating compositions are fed to the slide surfaces through slots 15a', 15b', and 15c'. The layers of coating compositions flow down slide surfaces 11', 12', and 13' by gravity to the edge of the hopper where a free falling curtain 26 is formed. As the web 18' passes around coating roller 16', the falling curtain 26 impinges on the web and deposits thereon a composite coating of three distinct layers of coating composition. The shield structure 24 is shaped so that it remains closely spaced and essentially parallel to the slide surfaces including the lower slide surface 27 which is contiguous with the surface 13' and is approximately vertical for supplying coating composition to the vertical free falling curtain.

The shield structure 24 of this embodiment also is desirably spaced about 0.6 centimeter from the slide surfaces. This distance can be extended

somewhat to about 1.0 centimeter when the shield is heated in order to prevent condensation of coating solvents on the surface of the shield facing the slide surfaces of the hopper.

The thickness of the hollow shield structure can be, for example, approximately 2.5 centimeters. It is hollow and has ports 24a and 24b for flow of heating fluid. The design of the shield depends on the material of construction for the shield and its capability of transmitting heat, as well as the thermal transfer coefficient of the heating fluid within the hollow structure.

The shield structure 24 is pivoted at 28 for movement between an operative position, illustrated in solid lines, and a retracted position, illustrated in broken lines, which allows operators access to the slide surfaces and exists 15a', 15b', and 15c'.

Fig. 3 illustrates a third embodiment of the present invention which is generally similar to the second embodiment. Parts and features in the third embodiment corresponding to parts and features in the second embodiment are given the same reference numerals, but with a double prime ('') suffix. For an understanding of aspects of the third embodiment not described, reference is directed to the description above. The shield structure 34, instead of being hollow, is formed of a rigid sheet of metal, such as stainless steel, which is positioned in close proximity and adjacent to the slide surfaces 11", 12", and 13" as described above. An electric heating blanket 36 is bonded to shield structure 34 and has a heat producing capacity sufficient to heat the shield structure surface to a temperature of from about 35°C to 50°C. Shield structure 34 is pivotable about hinge point 38 to allow the shield structure to be moved away from the hopper surface.

Industrial Applicability

The invention is applicable to apparatus for coating a web or sheet with fluid composition as a step in the production of photographic material.

The closely spaced shield of the present invention can be used in conjunction with other shield structures designed to minimize the effect of forced ambient air currents, such as those disclosed in U.S. Patent 4,287,240. The closely spaced shield of the present invention is effective in minimizing or eliminating convection air currents generated by the coating hopper and the coating compositions flowing on the hopper slide surfaces.

We Claim:

1. Apparatus for coating a web or sheet with a coating composition in the manufacture of photographic material, including:

a. means for guiding the web or sheet along a predetermined path through a coating zone; and

b. slide hopper means having a slide surface for forming a flow of coating composition to be applied to the web or sheet; characterized by

c. shield means disposed in close proximity to said slide surface whereby, in use, the shield means is out of contact with the flowing composition but is so closely spaced therefrom as to prevent the creation of convection currents by a temperature differential between the composition and the atmosphere in contact with the composition.

2. Apparatus as claimed in claim 1, further including:

a. means for heating said shield means to a temperature at least equal to that of the coating composition.

3. Apparatus as claimed in claim 2, wherein said means for heating said shield means includes passage means within said shield means, for flow of heated fluid.

4. Apparatus as claimed in claim 2, wherein said heating means includes an electrically energized heating blanket in thermal contact with said shield means.

5. Apparatus as claimed in claim 1, 2, 3, or 4, wherein said shield means is spaced less than about 1.0 cm from said slide surface.

6. Apparatus a claimed in claim 1, 2, 3, or 4, wherein said shield means is spaced from said hopper surface by about 0.6 cm.

7. Apparatus as claimed in claim 1, 2, 3, or 4, wherein said means for guiding a web or sheet is adapted to guide a web, and said slide hopper means is disposed adjacent said means for guiding a web and is adapted to coat by the bead coating process.

8. Apparatus as claimed in claim 1, 2, 3, or 4, wherein said slide hopper means is disposed above and in spaced relationship to said means for guiding said web or sheet and is adapted to coat by the curtain coating process.

AMENDED CLAIMS

[received by the Internationl Bureau on 5 December 1989 (05.12.89) original claim 1 amended; other claims unchanged (1 page)]

1. Apparatus for coating a web or sheet with a coating composition in the manufacture of photographic material, including:

a. means for guiding the web or sheet along a predetermined path through a coating zone; and

b. slide hopper means having an inclined slide surface for forming a flow of coating composition to be applied to the web or sheet; characterized by

c. shield means disposed in close proximity to said slide surface whereby, in use, the shield means is permanently out of contact with the flowing composition but is so closely spaced therefrom as to prevent the creation of convection currents by a temperature differential between the composition and the atmosphere in contact with the composition.

2. Apparatus as claimed in claim 1, further including:

a. means for heating said shield means to a temperature at least equal to that of the coating composition.

3. Apparatus as claimed in claim 2, wherein said means for heating said shield means includes passage means within said shield means, for flow of heated fluid.

4. Apparatus as claimed in claim 2, wherein said heating means includes an electrically energized heating blanket in thermal contact with said shield means.

5. Apparatus as claimed in claim 1, 2, 3, or 4, wherein said shield means is spaced less than about 1.0 cm from said slide surface.

6. Apparatus a claimed in claim 1, 2, 3, or 4, wherein said shield means is spaced from said hopper surface by about 0.6 cm.

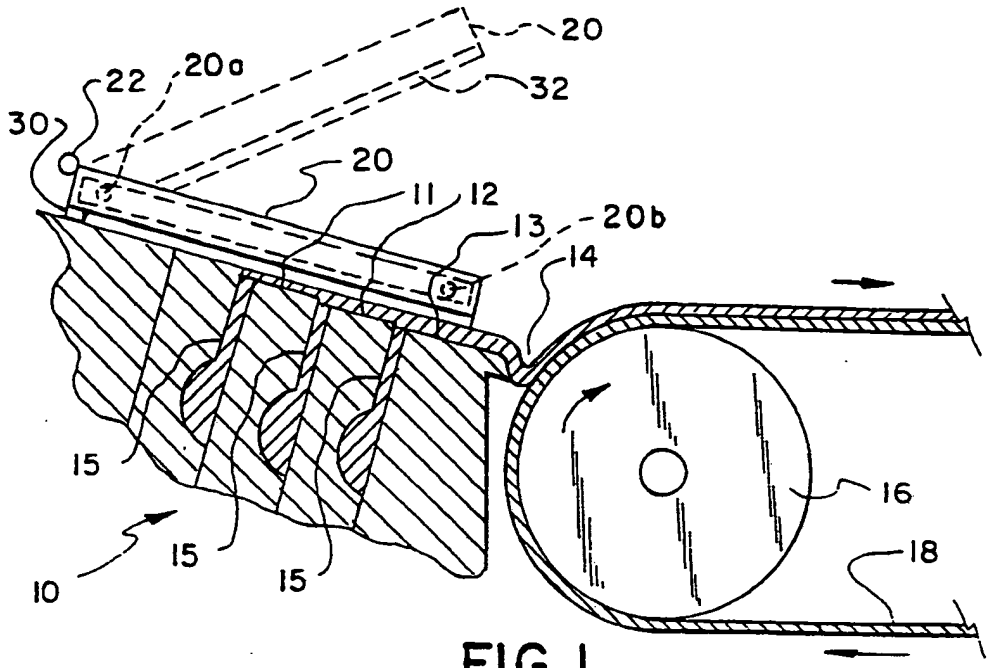
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FIG.1

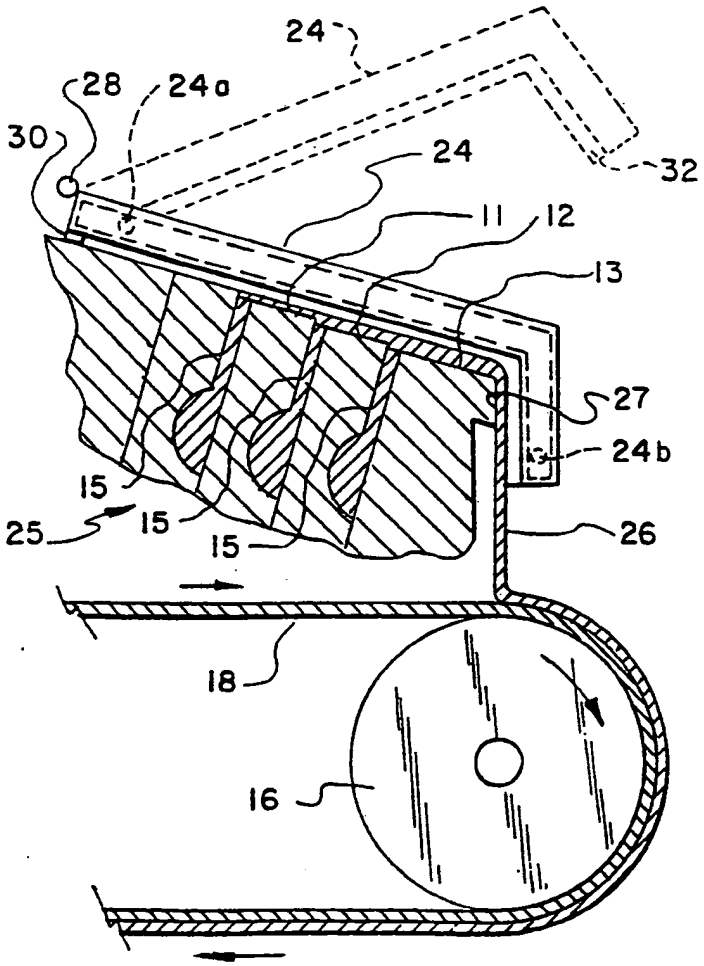
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FIG.2

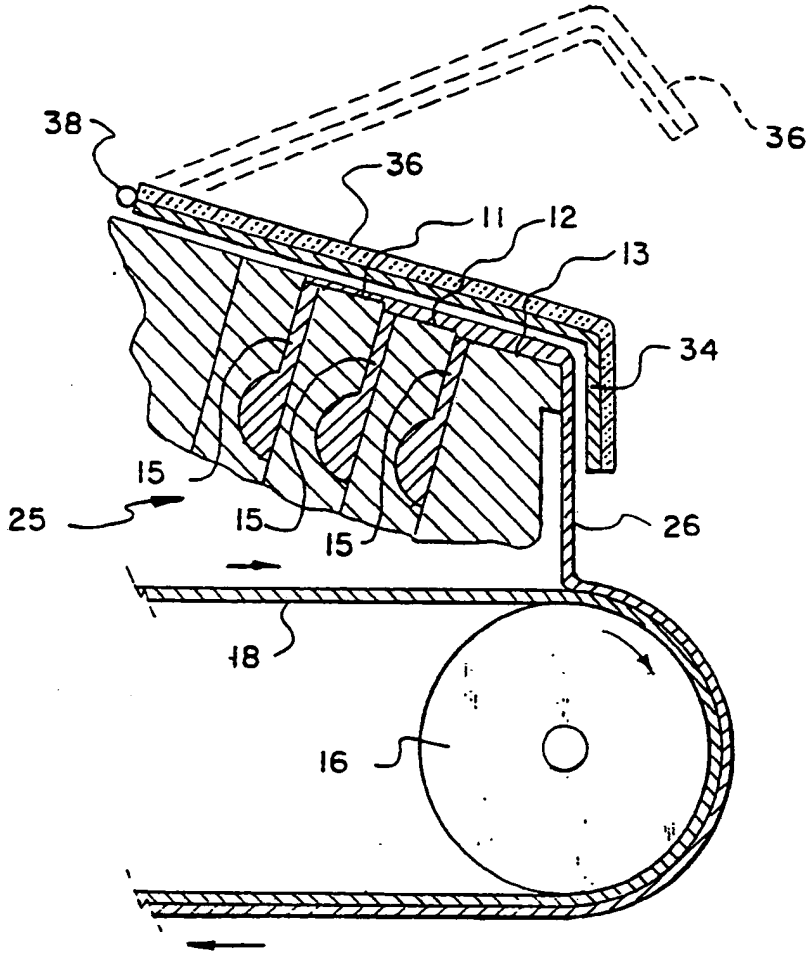

FIG.3

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 89/03082

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: G 03 C 1/74, B 05 C 9/06

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	G 03 C 1/00, B 05 C 9/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	DE, A, 3110821 (FUJI PHOTO FILM CO., LTD) 25 February 1982 see page 11, lines 12-29; page 12, lines 12-15; claims 6,8; figure 7 --	1,5-8
X	Research disclosure, no. 189, January 1980, (Havant, Hampshire, GB), "Curtain coating", pages 15-16, disclosure no. 18916, see the whole article --	1,5,6,8
A	GB, A, 2038211 (FUJI PHOTO FILM CO., LTD) 23 July 1980 see figure 2; page 2, lines 58-65 --	1
A	US, A, 4287240 (EASTMAN KODAK CO.) 1 September 1981 cited in the application ---------	

* Special categories of cited documents: [10]

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21st September 1989	13 OCT 1989
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	T.K. WILLIS

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 8903082 SA 30130

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 06/10/89
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 3110821	25-02-82	JP-A- 56133067	17-10-81
GB-A- 2038211	23-07-80	JP-A- 55075758	07-06-80
		DE-A- 2948962	19-06-80
		US-A- 4292349	29-09-81
US-A- 4287240	01-09-81	AU-B- 541106	13-12-84
		AU-A- 7079781	26-10-81
		BE-A- 888376	12-10-81
		CA-A- 1156101	01-11-83
		CH-A- 645822	31-10-84
		DE-T- 3142257	08-01-87
		FR-A,B 2480144	16-10-81
		GB-A,B 2085763	06-05-82
		WO-A- 8102856	15-10-81